

WHAT IS CLAIMED IS:

- 1 1. A canal hearing device comprising:
 - 2 a main module, and a tubular insert axially and removably connected to said main
 - 3 module;
 - 4 said main module comprising a housing including a receiver for producing sound, said
 - 5 main module being constructed and adapted to be at least partially positioned in the
 - 6 cartilaginous part of an ear canal of a wearer of said device;
 - 7 said tubular insert comprising a sound conduction tube having a diameter substantially
 - 8 less than the diameter of said ear canal, said sound conduction tube being constructed and
 - 9 adapted to be positioned in said ear canal for delivering sound produced by said receiver
 - 10 toward and in proximity of the tympanic membrane of said wearer; a primary seal concentrically
 - 11 positioned over said sound conduction tube to seal said ear canal in the bony part thereof and
 - 12 to form a first space between said primary seal and said tympanic membrane, and a secondary
 - 13 seal positioned laterally of said primary seal to provide sealing in the cartilaginous part of said
 - 14 ear canal and to form a second space between said secondary seal and said primary seal when
 - 15 said canal hearing device is worn in said ear canal; and a venting system including a relatively
 - 16 small pressure vent associated with said primary seal, and a relatively larger occlusion-relief
 - 17 vent associated with said secondary seal to acoustically connect said second space to space
 - 18 outside of said ear canal, said occlusion-relief vent constituting a path of least acoustic
 - 19 resistance for leaking occlusion sounds relative to said pressure vent;

20 whereby, when said canal hearing device is worn in said ear canal, said venting system
21 provides substantial acoustic sealing of sound delivered in said first space, while simultaneously
22 attenuating said occlusion sounds by directing said occlusion sounds away from said tympanic
23 membrane.

1 **2.** The canal hearing device of claim 1, wherein:
2 said tubular insert is constructed and adapted to be disposable for selective replacement
3 thereof.

1 **3.** The canal hearing device of claim 1, wherein:
2 said tubular insert is radially flexible and axially sufficiently rigid for proper insertion
3 of said device in said ear canal.

1 **4.** The canal hearing device of claim 1, wherein:
2 said tubular insert possesses structural characteristics of being kink-resistant and non-
3 collapsible when said device is inserted in said ear canal.

1 **5.** The canal hearing device of claim 4, wherein:
2 said sound conduction tube includes a skeletal frame incorporated therein to at least
3 partially achieve said structural characteristics of said tubular insert.

1 **6.** The canal hearing device of claim 4, wherein:
2 said sound conduction tube includes circular, longitudinal, helical or braided elements
3 therein to at least partially achieve said structural characteristics of said tubular insert.

1 **7.** The canal hearing device of claim 1, wherein:
2 said tubular insert has generic configurations and sizes, to accommodate any of a variety
3 of ear canal sizes and shapes.

1 **8.** The canal hearing device of claim 1, wherein:
2 said tubular insert comprises multiple tubing for use either in multiple channel sound
3 conduction or venting.

1 **9.** The canal hearing device of claim 1, wherein:
2 said sound conduction tube is at least 8 mm in length.

1 **10.** The canal hearing device of claim 1, wherein:
2 said sound conduction tube has an inside diameter not greater than 2 mm.

1 **11.** The canal hearing device of claim 1, wherein:
2 said sound conduction tube is constructed and adapted to provide a boost for conducted
3 sounds at the high range of audiometric frequencies.

1 **12.** The canal hearing device of claim 1, wherein:

2 said pressure vent is in the form of a hole, cavity, slit, or tube having a diameter or

3 width not greater than 0.5 mm.

1 **13.** The canal hearing device of claim 1, wherein:

2 said pressure vent is incorporated directly on said primary seal.

1 **14.** The canal hearing device of claim 1, wherein:

2 said pressure vent is indirectly incorporated along said sound conduction tube or a

3 connector associated with said sound conduction tube.

1 **15.** The canal hearing device of claim 1, wherein:

2 said sound conduction tube is constructed and adapted to extend medially past the

3 primary seal toward said tympanic membrane, when said canal hearing device is worn in said

4 ear canal.

1 **16.** The canal hearing device of claim 1, wherein:

2 at least one of said primary seal and said secondary seal is hollow and of generally

3 cylindrical shape.

1 **17.** The canal hearing device of claim 1, wherein:
2 at least one of said primary seal and said secondary seal is flanged, mushroom shaped,
3 or clustered.

1 **18.** The canal hearing device of claim 1, wherein:
2 the cross sectional perimeter of at least one of said primary seal and said secondary seal
3 is either circular, elliptical, or oval and inferiorly pointed.

1 **19.** The canal hearing device of claim 1, wherein:
2 at least one of said primary seal and said secondary seal is constructed and adapted to
3 contact the walls of said ear canal with a span of at least 2 mm longitudinally, when said canal
4 hearing device is worn in said ear canal.

1 **20.** The canal hearing device of claim 1, wherein:
2 said main module has a generic shape.

1 **21.** The canal hearing device of claim 1, wherein:
2 said main module is substantially vented.

1 **22.** The canal hearing device of claim 1, wherein:
2 said main module further comprises a receiver section having a diameter substantially

3 less than the diameter of said ear canal, to allow insertion of said main module into the
4 cartilaginous part of said ear canal medially past the aperture thereof.

1 **23.** The canal hearing device of claim **22**, wherein:

2 said receiver section comprises a medial connector for removably connecting to said
3 tubular insert.

1 **24.** The canal hearing device of claim **23**, wherein:

2 said medial connector comprises either a snap-on, threaded, spring-loaded, pressure-fit,
3 or side-slide mating mechanism.

1 **25.** The canal hearing device of claim **22**, wherein:

2 said tubular insert further includes a tube connector for concentric coaxial connection
3 of said receiver section to said tubular insert.

1 **26.** The canal hearing device of claim **1**, wherein:

2 said secondary seal provides physical support for either the main module or the tubular
3 insert.

1 **27.** The canal hearing device of claim **1**, wherein:

2 said occlusion-relief vent comprises a cross sectional area at least 3 times that of said

3 pressure vent.

1 **28.** The canal hearing device of claim 1, wherein:
2 said occlusion-relief vent is configured to provide acoustic impedance at least 10
3 decibels less than the acoustic impedance of said pressure vent for frequencies below 500 hz.

1 **29.** The canal hearing device of claim 1, further including:
2 manual control means associated with said device for manually adjusting at least one
3 parameter thereof.

1 **30.** The canal hearing device of claim 1, further including:
2 remote control means associated with said device for remotely controlling or adjusting
3 at least one parameter thereof.

1 **31.** The canal hearing device of claim 30, wherein:
2 said remote control means comprises one or more latchable reed switches within said
3 main module, and an external control magnet for operation of said one or more latchable reed
4 switches to effect said control or adjustment.

1 **32.** The canal hearing device of claim 1, further including:
2 means associated with said device for programming thereof.

1 **33.** The canal hearing device of claim **32**, further including:
2 an electrical connector associated with said device for programming thereof.

1 **34.** The canal hearing device of claim **32**, further including:
2 wireless connection means associated with said device for programming thereof.

1 **35.** The canal hearing device of claim **1**, wherein:
2 said device is adapted for hearing enhancement of a hearing impaired wearer.

1 **36.** The canal hearing device of claim **1**, wherein:
2 said device is adapted for audio communications.

1 **37.** The canal hearing device of claim **36**, further including:
2 electrical connector means associated with said device for connection to an external
3 audio device.

1 **38.** The canal hearing device of claim **1**, further including:
2 wireless interface means associated with said device for receiving wireless signals.

1 39. A tubular insert adapted for axial and removable connection to a hearing device,
2 said tubular insert comprising:

3 a sound conduction tube constructed and adapted to be positioned in an ear canal of
4 a wearer of said device for delivering sound produced by said device toward and in proximity
5 of the tympanic membrane of said wearer,

6 a primary seal concentrically positioned over said sound conduction tube to seal said
7 ear canal in the bony part thereof and to form a first space between said primary seal and said
8 tympanic membrane, and a secondary seal concentrically positioned over said sound conduction
9 tube laterally of said primary seal to provide sealing in the cartilaginous part of said ear canal
10 and to form a second space between said secondary seal and said primary seal when said
11 tubular insert is worn in said ear canal; and

12 a venting system including a relatively small pressure vent associated with said primary
13 seal, and a relatively larger occlusion-relief vent associated with said secondary seal to
14 acoustically connect said second space to space outside of said ear canal, said occlusion-relief
15 vent constituting a path of least acoustic resistance for leaking occlusion sounds relative to said
16 pressure vent;

17 whereby, when said tubular insert is worn in said ear canal, said venting system provides
18 substantial acoustic sealing for sound delivered in said first space, while simultaneously
19 attenuating occlusion sounds in said first space by directing said occlusion sounds away from
20 said tympanic membrane.

1 **40.** The tubular insert of claim **39**, wherein:
2 said tubular insert is constructed and adapted to be disposable for selective replacement
3 thereof.

1 **41.** The tubular insert of claim **39**, wherein:
2 said tubular insert is radially flexible and axially sufficiently rigid for proper insertion
3 of said tubular insert in said ear canal.

1 **42.** The tubular insert of claim **39**, wherein:
2 said tubular insert is constructed and adapted to possess structural characteristics of
3 kink-resistance and non-collapse when inserted in said ear canal.

1 **43.** The tubular insert of claim **42**, wherein:
2 said sound conduction tube includes a skeletal frame incorporated therein to at least
3 partially produce said structural characteristics.

1 **44.** The tubular insert of claim **42**, wherein:
2 said sound conduction tube includes circular, longitudinal, helical or braided elements
3 therein to at least partially produce said structural characteristics.

1 **45.** The tubular insert of claim 39, wherein:
2 said tubular insert has generic configurations and sizes to accommodate any of a variety
3 of ear canal sizes and shapes.

1 **46.** The tubular insert of claim 39, including:
2 multiple tubing for either multiple channel sound conduction or venting.

1 **47.** The tubular insert of claim 39, wherein:
2 said sound conduction tube is at least 8 mm in length.

1 **48.** The tubular insert of claim 39, wherein:
2 said sound conduction tube has an inside diameter not greater than 2 mm.

1 **49.** The tubular insert of claim 39, wherein:
2 said sound conduction tube is constructed and adapted to provide a boost for conducted
3 sounds at the high range of audiometric frequencies.

1 **50.** The tubular insert of claim 39, wherein:
2 said pressure vent is in the form of a hole, cavity, slit, or tube having a diameter or
3 width not greater than 0.5 mm.

1 **51.** The tubular insert of claim 39, wherein:
2 said pressure vent is incorporated directly on said primary seal.

1 **52.** The tubular insert of claim 39, wherein:
2 said pressure vent is indirectly incorporated along said sound conduction tube or a
3 connector associated with said sound conduction tube.

1 **53.** The tubular insert of claim 39, wherein:
2 said sound conduction tube is constructed and adapted to extend medially past said
3 primary seal toward said tympanic membrane, when said tubular insert is worn in said ear canal.

1 **54.** The tubular insert of claim 39, wherein:
2 at least one of said primary seal and said secondary seal is hollow and of generally
3 cylindrical shape.

1 **55.** The tubular insert of claim 39, wherein:
2 at least one of said primary seal and said secondary seal is flanged, mushroom shaped,
3 or clustered.

1 **56.** The tubular insert of claim 39, wherein:
2 the cross sectional perimeter of at least one of said primary seal and said secondary seal

3 is either circular, elliptical, or oval and inferiorly pointed.

1 **57.** The tubular insert of claim 39, wherein:

2 at least one of said primary seal and said secondary seal is constructed and adapted to
3 contact the walls of said ear canal with a span of at least 2 mm longitudinally, when said tubular
4 insert is worn in said ear canal.

1 **58.** The tubular insert of claim 39, wherein:

2 at least one of said primary seal and said secondary seal further comprises medication
3 material selected from a group including anti-bacterial and anti-microbial agents.

1 **59.** The tubular insert of claim 39, wherein:

2 at least one of said primary seal and said secondary seal further comprises lubricant to
3 facilitate insertion and removal of said tubular insert into and from said ear canal.

1 **60.** The tubular insert of claim 39, including:

2 means for removably connecting said tubular insert to a receiver section within said
3 hearing device.

1 **61.** The tubular insert of claim 60, wherein:

2 said connecting means comprises a snap-on, threaded, spring-loaded, pressure-fit, or

3 side-slide mating mechanism.

1 **62.** The tubular insert of claim 60, further including:

2 a tube connector for concentric coaxial connection of said tubular insert over said
3 receiver section.

1 **63.** The tubular insert of claim 39, wherein:

2 said occlusion-relief vent comprises a cross sectional area at least 3 times that of said
3 pressure vent.

1 **64.** The tubular insert of claim 39, wherein:

2 said occlusion-relief vent is configured to provide acoustic impedance at least 10
3 decibels less than the acoustic impedance of said pressure vent for frequencies below 500 hz.

1 **65.** The tubular insert of claim 39, including:

2 means adapting said tubular insert for hearing enhancement of a hearing impaired
3 wearer.

1 **66.** The tubular insert of claim 39, including:

2 means adapting said tubular insert for audio communications.

1 **67.** A canal hearing device comprising:

2 a main module, and a tubular insert axially and removably connected to said main
3 module;

4 said main module comprising a housing including a receiver for producing sound, said
5 main module being constructed and adapted to be at least partially positioned in the
6 cartilaginous part of an ear canal of a wearer of said device;

7 said tubular insert comprising a sound conduction tube having a diameter substantially

8 less than the diameter of said ear canal, said sound conduction tube being constructed and
9 adapted to be positioned in said ear canal for delivering sound produced by said receiver
10 toward and in proximity of the tympanic membrane of said ear canal, and a primary seal
11 concentrically positioned over said sound conduction tube to seal said ear canal and to form
12 a first space between said primary seal and said tympanic membrane when said device is worn
13 in said ear canal, said primary seal having an associated pressure vent for said first space;

14 said main module further comprising a secondary seal to provide sealing in the

15 cartilaginous part of said ear canal lateral to said primary seal and forming a second space
16 between said primary and secondary seals when said main module and said tubular insert are
17 connected and worn in said ear canal, and an occlusion-relief vent acoustically connecting said
18 second space to space outside of said ear canal, said occlusion-relief vent constituting a path
19 of least acoustic resistance relative to said pressure vent;

20 whereby, when said canal hearing device is worn in said ear canal, said primary and

21 secondary seals and occlusion-relief vent, in combination, provide substantial acoustic sealing

22 of sound delivered in said first space, while simultaneously attenuating occlusion sounds by
23 directing said occlusion sounds away from said tympanic membrane.

1 **68.** The canal hearing device of claim 67, wherein:
2 said tubular insert is constructed and adapted to be disposable for selective replacement
3 thereof.

1 **69.** The canal hearing device of claim 67, wherein:
2 said tubular insert is radially flexible and axially sufficiently rigid for proper insertion
3 of said device in said ear canal.

1 **70.** The canal hearing device of claim 67, wherein:
2 said tubular insert has structural characteristics of being kink-resistant and non-
3 collapsible when said device is inserted in said ear canal.

1 **71.** The canal hearing device of claim 70, wherein:
2 said sound conduction tube includes a skeletal frame incorporated therein to at least
3 partially produce said structural characteristics of said tubular insert.

1 **72.** The canal hearing device of claim 70, wherein:
2 said sound conduction tube includes circular, longitudinal, helical or braided elements

3 therein to at least partially produce said structural characteristics of said tubular insert.

1 **73.** The canal hearing device of claim 67, wherein:

2 said tubular insert has generic configurations and sizes to accommodate any of a variety
3 of ear canal sizes and shapes.

1 **74.** The canal hearing device of claim 67, wherein:

2 said tubular insert comprises multiple tubing for either conduction of multiple channel
3 sound or venting.

1 **75.** The canal hearing device of claim 67, wherein:

2 said sound conduction tube is at least 8 mm in length.

1 **76.** The canal hearing device of claim 67, wherein:

2 said sound conduction tube has an inside diameter not greater than 2 mm.

1 **77.** The canal hearing device of claim 67, wherein:

2 said sound conduction tube is constructed and adapted to provide a boost for conducted
3 sounds at the high range of audiometric frequencies.

1 **78.** The canal hearing device of claim 67, wherein:

2 said pressure vent is in the form of a hole, cavity, slit, or tube having a diameter or
3 width not greater than 0.5 mm.

1 **79.** The canal hearing device of claim 67, wherein:
2 said pressure vent is incorporated directly on said primary seal.

1 **80.** The canal hearing device of claim 67, wherein:
2 said pressure vent is indirectly incorporated along said sound conduction tube or a
3 connector associated with said sound conduction tube.

1 **81.** The canal hearing device of claim 67, wherein:
2 said sound conduction tube is constructed and adapted to extend medially past said
3 primary seal toward said tympanic membrane, when said canal hearing device is worn in said
4 ear canal.

1 **82.** The canal hearing device of claim 67, wherein:
2 said primary seal is hollow and of generally cylindrical shape.

1 **83.** The canal hearing device of claim 67, wherein:
2 said primary seal is flanged, mushroom shaped, or clustered.

1 **84.** The canal hearing device of claim 67, wherein:
2 the cross sectional perimeter of said primary seal is either circular, elliptical, or oval and
3 inferiorly pointed.

1 **85.** The canal hearing device of claim 67, wherein:
2 said primary seal is constructed and adapted to contact the walls of said ear canal with
3 a span of at least 2 mm longitudinally, when said canal hearing device is worn in said ear canal.

1 **86.** The canal hearing device of claim 67, wherein:
2 said main module has a generic shape.

1 **87.** The canal hearing device of claim 67, wherein:
2 said main module is substantially vented for occlusion relief.

1 **88.** The canal hearing device of claim 67, wherein:
2 said main module further comprises a receiver section having a diameter substantially
3 less than the diameter of said ear canal, for insertion of said main module into the cartilaginous
4 part of said ear canal medially past the aperture thereof.

1 **89.** The canal hearing device of claim 88, wherein:
2 said receiver section comprises a medial connector for removably connecting to said

3 tubular insert.

1 **90.** The canal hearing device of claim **89**, wherein:

2 said medial connector comprises either a snap-on, threaded, spring-loaded, pressure-fit,
3 or side-slide mating mechanism.

1 **91.** The canal hearing device of claim **88**, wherein:

2 said tubular insert further includes a tube connector for concentric coaxial connection
3 of said receiver section to said tubular insert.

1 **92.** The canal hearing device of claim **67**, wherein:

2 said occlusion-relief vent comprises a cross sectional area at least 3 times that of said
3 pressure vent.

1 **93.** The canal hearing device of claim **67**, wherein:

2 said occlusion-relief vent is configured to provide acoustic impedance at least 10
3 decibels less than the acoustic impedance of said pressure vent for frequencies below 500 hz.

1 **94.** The canal hearing device of claim **67**, further including:

2 manual control means associated with said device for manually adjusting at least one
3 parameter thereof.

1 **95.** The canal hearing device of claim **67**, further including:
2 remote control means associated with said device for remotely controlling or adjusting
3 at least one parameter thereof.

1 **96.** The canal hearing device of claim **95**, wherein:
2 said remote control means comprises one or more latchable reed switches within said
3 main module, and an external control magnet for operation of said one or more latchable reed
4 switches to effect said control or adjustment.

1 **97.** The canal hearing device of claim **67**, further including:
2 means associated with said device for programming thereof.

1 **98.** The canal hearing device of claim **97**, further including:
2 an electrical connector associated with said device for programming thereof.

1 **99.** The canal hearing device of claim **97**, further including:
2 wireless connection means associated with said device for programming thereof.

1 **100.** The canal hearing device of claim **67**, wherein:
2 said device is adapted for hearing enhancement of a hearing impaired wearer.

1 **101.** The canal hearing device of claim 67, wherein:
2 said device is adapted for audio communications.

1 **102.** The canal hearing device of claim 101, further including:
2 electrical connector means associated with said device for connection to an external
3 audio device.

1 **103.** The canal hearing device of claim 67, further including:
2 wireless interface means associated with said device for receiving wireless signals.

1 **104.** A tubular insert for insertion into an ear canal of a wearer, said tubular insert
2 comprising:
3 a sound conduction tube for delivering sound in a sealing manner toward and in
4 proximity of the tympanic membrane of said wearer,
5 one or more seals concentrically positioned over said sound conduction tube, forming
6 a space between a medial one of said seals and said tympanic membrane; and
7 a skeletal frame incorporated in said sound conduction tube to render said tubular insert
8 radially flexible and axially rigid for comfortable and consistent insertion of said tubular insert
9 in said ear canal.

1 **105.** The tubular insert of claim 104, wherein:

2 said tubular insert is constructed and adapted to be disposable for selective replacement

3 thereof.

1 **106.** The tubular insert of claim 104, wherein:

2 said tubular insert is constructed and adapted to possess structural characteristics of

3 kink-resistance and non-collapse when inserted in said ear canal.

1 **107.** The tubular insert of claim 104, wherein:

2 said tubular insert has generic configurations and sizes to accommodate any of a variety

3 of ear canal sizes and shapes.

1 **108.** The tubular insert of claim 104, wherein:

2 said sound conduction tube comprises multiple tubing for either multiple channel sound

3 conduction or venting.

1 **109.** The tubular insert of claim 104, wherein:

2 said sound conduction tube is at least 8 mm in length.

1 **110.** The tubular insert of claim 104, wherein:

2 said sound conduction tube has an inside diameter not greater than 2 mm.

1 **111.** The tubular insert of claim 104, wherein:
2 said sound conduction tube is constructed and adapted to provide a boost for conducted
3 sounds at the high range of audiometric frequencies.

1 **112.** The tubular insert of claim 104, wherein:
2 said at least one seal comprises a pressure vent in the form of a hole, cavity, slit, or tube
3 having a diameter or width not greater than 0.5 mm.

1 **113.** The tubular insert of claim 112, wherein:
2 said pressure vent is incorporated directly on said at least one seal.

1 **114.** The tubular insert of claim 112, wherein:
2 said pressure vent is indirectly incorporated along said sound conduction tube or a
3 connector associated with said sound conduction tube.

1 **115.** The tubular insert of claim 104, wherein:
2 said sound conduction tube is constructed and adapted to extend medially past said at
3 least one seal toward said tympanic membrane, when said tubular insert is worn in said ear
4 canal.

1 **116.** The tubular insert of claim 104, wherein:
2 said one or more seals are hollow and of generally cylindrical shape.

1 **117.** The tubular insert of claim 104, wherein:
2 said one or more seals are flanged, mushroom shaped, or clustered.

1 **118.** The tubular insert of claim 104, wherein:
2 the cross sectional perimeter of each of said one or more seals is either circular,
3 elliptical, or oval and inferiorly pointed.

1 **119.** The tubular insert of claim 104, wherein:
2 said one or more seals are constructed and adapted to contact the walls of said ear canal
3 with a span of at least 2 mm longitudinally, when said tubular insert is worn in said ear canal.

1 **120.** The tubular insert of claim 104, wherein:
2 at least one of said one or more seals further comprises medication material selected
3 from a group including anti-bacterial and anti-microbial agents.

1 **121.** The tubular insert of claim 104, wherein:
2 at least one of said one or more seals further comprises lubricant to facilitate insertion
3 and removal of said tubular insert into and from said ear canal.

1 **122.** The tubular insert of claim **104**, including:

2 means for removably connecting said tubular insert to a receiver section within a
3 hearing device.

1 **123.** The tubular insert of claim **122**, wherein:

2 said connecting means comprises a snap-on, threaded, spring-loaded, pressure-fit, or
3 side-slide mating mechanism.

1 **124.** The tubular insert of claim **122**, further including:

2 a tube connector for concentric coaxial connection of said tubular insert over said
3 receiver section.

1 **125.** The tubular insert of claim **104**, including:

2 means adapting said tubular insert for hearing enhancement of a hearing impaired wearer.

1 **126.** The tubular insert of claim **104**, including:

2 means adapting said tubular insert for audio communications.

1 **127.** The tubular insert of claim **104**, wherein:

2 at least one of said seals is positioned in the bony part of said ear canal.